QUAKE-UP CALL

There's a massive earthquake in Portland's future—and the "Prophet of Doom" will tell you all about it. By Aaron Mesh.

OREGON'S ORACLE: The Oregon Department of Geology and Mineral Industries' James Roddey says structures like Big Pink and the Steel Bridge are imperiled. "Bake some cookies," he says, "take 'em to your neighbors and say, 'When the big one hits, rescue me first.'"

In the reasonably near future, perhaps within our lifetimes, and quite possibly as soon as tomorrow, an earthquake will strike Portland with roughly the same force felt this month in Port-au-Prince.

But while the January 12 Haitian quake lasted less than 40 seconds, the shaking in Portland will continue for at least four minutes. Portland will feel a quake with a strength, duration and destruction never before experienced in a modern american city.

Our cataclysm will begin 75 miles off the Oregon coastline. The ocean floor will split, sending shock waves racing under the water as fast as 17,000 mph. Those shock waves, felt first as a rumble, will slam into Portland moments later. The shaking will grow into a pulsing undulation that will repeatedly shove the ground up and down as much as 6 feet.

Landslides will ensue in the West Hills, sending mansions crashing on top of each other. Several of the 10 bridges across the Willamette River will suffer severe damage—the Sellwood, Ross Island and Hawthorne Bridges, most likely—and the rest will be impassible. Big Pink and other office towers will sway so violently their granite and glass façades will shear off and crash into the street, piling rubble up 4 feet deep. The Multnomah County Courthouse will tumble. Underground gas, power and water lines will be pulverized. The soil beneath the Portland International Airport will temporarily turn to soup.

About half an hour later, a 30-foot wall of water will crash into the Oregon coastline, with the tsunami flooding some areas perhaps as high as 100 feet above sea level, sweeping in and out for hours.

MORE BAD NEWS

Shallow, crustal earthquake faults ring the Portland metro area. In 1993, the magnitude 5.6 "Spring Break" quake, centered 40 miles south of Portland in Scotts Mills, caused over $30 million in damage to the metro area. Portland also has three crustal faults running under the city, each of which could trigger earthquakes as large as a magnitude 6.5: The Oatfield Fault lies in Washington County, the Portland Hills Fault runs along Highway 30 and under downtown, and the East Bank Fault is on the east shore of the Willamette River.

This is not a pitch for the next Hollywood disaster movie. It is the scientific consensus on what will happen here sooner or later. And the latest data suggest it may in fact be sooner.

In the wake of the Haitian calamity, the human heart fills with compassion—and then with gratitude that it wasn't us, and fear of when it might be. It is the job of one state employee to make you understand why that fear is actually justified.

IT'S OUT THERE: Standing near Seaside High School, Roddey lectures on the effects of a tsunami generated by an offshore Cascadia earthquake to middle-school science teachers from across Oregon.

The man tasked with sounding the alarm for this impending catastrophe is not a scientist or an emergency response official. James Roddey is the Earth Sciences Information Officer for the Oregon Department of Geology and Mineral Industries. In other words, the Cassandra of our day is a geology geek with a streak of showmanship.

From a home base on the ninth floor of a state government building (itself likely to remain standing but be severely damaged in a major quake) in the Lloyd District, Roddey takes his warning each year to dozens of cities in Oregon. His presentation, honed over a decade to include Native American myths, scientific detective stories, jokey anecdotes and group exercises, all to lighten the mood, is delivered to city councils and Kiwanis Clubs at a rate of about one presentation a week.

He is a showman with a carefully honed patter—his stage presence falls somewhere between Al Gore and Tony Robbins. With a salt-and-pepper goatee and glasses, he looks a little like Stephen King, and uses his storyteller's intensity to achieve the magnetic effects of any good evangelist.

The 55-year-old Roddey sees his job as karma-balancing atonement for 20 years spent in television as a marketing director and producer. He never planned to work as a spokesman for scientists; at Wofford College in South Carolina, he majored in English, though he took every geology course offered at the small private college.

Native Americans have populated the Pacific Northwest for at least 10,000 years as is evidenced by petroglyphs (above) found throughout the region, and have passed on stories of great earthquakes and tsunamis to present generations.

NATIVE MYTHS AND LEGENDS

It wasn't until about 15 years ago that Native American myths and historical narratives that mention earthquakes and tsunamis in the Pacific Northwest were recognized as factual stories. Roddey incorporates these stories into his presentations to engage the audience in not only the symbolism and importance of the information contained in the stories, but to make the point that these stories are speaking of events that happened hundreds of years ago. "There's an oral tradition, passed on from one generation to the next, of what do when the ground shakes," said Roddey. "That's the culture of awareness we have to create today. It's our duty as keepers of this knowledge."

In Flagstaff, Arizona, in the mid—1990s, he produced and directed "Geonauts", an educational TV series for the The Learning Channel (TLC) in partnership with the National Park Service. The Grand Canyon was the outdoor classroom for the geology based program's 65 episodes. When Geonauts folded after 2 seasons, he jumped back into commercial television before spotting a newspaper ad for the Oregon Department of Geology and Mineral Industries public-relations job.

Roddey sometimes helps coordinates a range of local and state agencies for emergency—preparation exercises. In this most recent exercise called Cascadia Peril, his computer model calculated 9,650 casualties and tens of thousands of injuries in Oregon after the expected big earthquake and resultant tsunami.

"It may only be a few hundred people," he says, "if they listen to the warnings."

In his presentations to civic organizations, he delivers a message unlikely to come from many other state officials: Don't expect the government to help you. (The warning is perhaps more resonant in a city that essentially shuts down when it gets an inch of snow.)

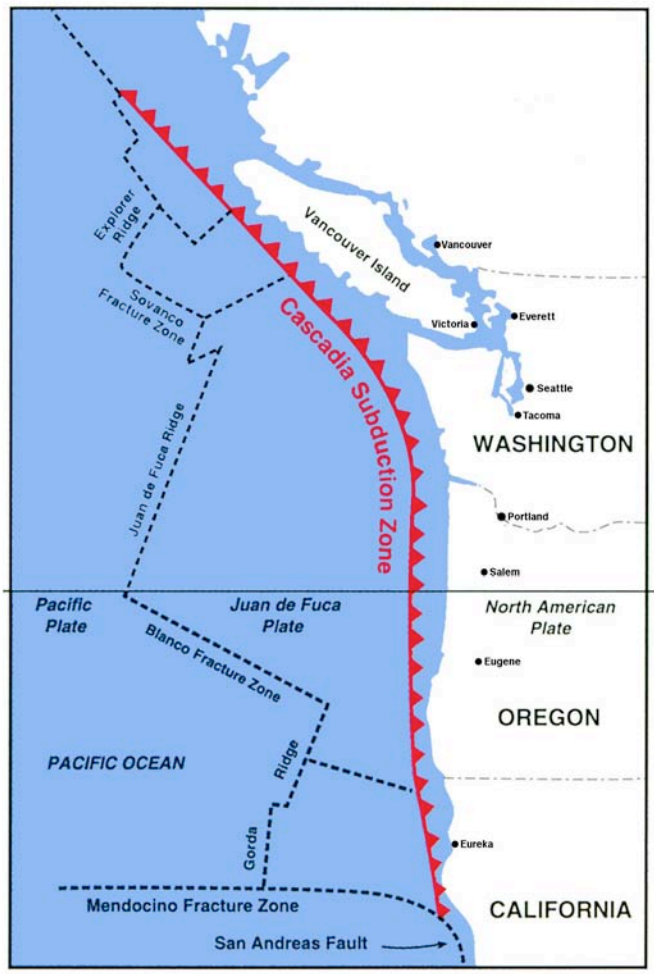
"I encourage everyone to take personal responsibility in getting prepared for an event like this," he says. "The white hats are not coming. The police and fire departments are going to be really busy. You're on your own."

Roddey believes Oregon's government agencies are doing everything they can to prepare, under the constraints of shrunken budgets and the inevitable psychological apathy that comes with preemptively responding to an emergency that has never been seen. I ask him if Oregon is ready.

He pauses. "I'm not ready for an event like this," he says. "And I'm probably the most paranoid person in the state."

The prospective upheaval that Oregonians aren't ready for is called a *mega-thrust earthquake* or, in scientific terminology both more precise and more euphemistic, a Cascadia Subduction Zone event.

"If you divorce yourself from the human element," Roddey says, "it's just an astounding geologic event."



IT'S COMPLICATED: A mash-up of small tectonic plates sit off the northwest coast, with the North American plate pushing against all of them.

It is undeniably interesting. About 75 miles off the Pacific coastline, two plates in the earth's crust meet on a crushing fault line stretching from midway up Vancouver Island down to Humboldt County, California. Along the length of this 700-mile-long fault, the Juan de Fuca tectonic plate is slowly scraping under the North American plate, building up pressure—much like slipping your foot under the edge of a Persian rug, which curls up until it pops free.

The latest studies of undersea landslide debris associated with these great earthquakes, released last spring by Oregon State University geologist Chris Goldfinger, suggests a Cascadia Subduction Zone quake happens

Brian Atwater digs for clues to ancient earthquakes in a tidal flat on Youngs Bay, near Astoria. The layers here show evidence of three massive earthquakes in the past 1,000 years.

ANCIENT CLUES IN TIDAL MUD AND TREE RINGS

Until the early 1980s, scientists worked under the hypothesis that the Cascadia subduction zone was either inactive or the subduction process, where one tectonic plate slides under another, didn't cause earthquakes. But then U.S. Geological Survey scientist Brian Atwater found evidence, in tidal marshes in Willapa Bay, Washington and a ghost forest of ancient western red cedars on the Copalis River nearby, that suggested the process of subduction along the Pacific Northwest's continental shelf wasn't so benign after all.

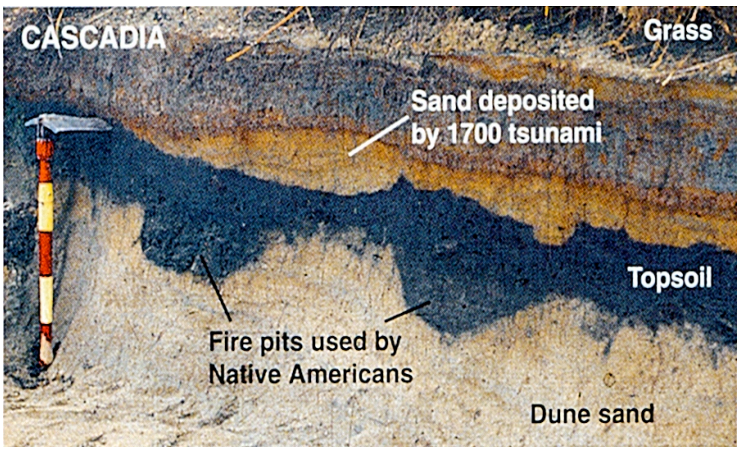
much more frequently than previously thought, perhaps a time-span as short as every 240 years or so.

The last one occurred 310 years ago yesterday.

It was 9 PM on Jan. 26, 1700. A massive earthquake rips a 700 mile long chunk of the sea floor apart and the giant wave generated from that rupture inundates the coastal tribal villages of the Pacific Northwest (and becomes part of their oral legends).

We know the exact time and date because a Japan Geological Survey researcher found historical records in coastal Japanese provinces showing unusual flooding of rice paddies and fishing villages—on Jan. 27, 1700. These findings, published in 1995, combined with earlier evidence uncovered in tidal marshes and coastal forests by U.S. Geological Survey (USGS) geologist Brian Atwater and others, proved the tide (actually a tsunami) arose from a distant Pacific Northwest earthquake.

The tsunami, traveling at 500 miles an hour, took about 10 hours to reach Japan, the result of an earthquake measuring somewhere from a magnitude 8.7 to a 9.2—that's the same size as the 2004 Indian Ocean mega-thrust earthquake and tsunami that killed nearly 230,000 people.



A LAYER-CAKE OF EARTHQUAKES: Tidal marshes up and down the northwest coast record the same layer-cake evidence of past earthquakes and tsunamis.

Conventional scientific estimates by the USGS place the odds of a similar major earthquake in the next 50 years at 10 percent to 14 percent—about an 1-in-8 chance.

Goldfinger's new research and methodology suggests a much higher probability. With geologic evidence he's gathered of 41 subduction zone earthquakes over the last 10,000 years, the law of averages says we're overdue for another big shake by decades. Not everybody accepts Goldfinger's conclusions, but Roddey says his research and his conclusions make a "very compelling argument."

So, when Oregon's luck runs out, what exactly will happen?

Standing in the Department of Geology conference room back in the Lloyd District, with a stunning westward view of the Rose Quarter Arena, the

Willamette River and downtown Portland, Roddey and I engage in some very speculative rubbernecking.

In a magnitude 9.0 offshore earthquake, which, by the time its shock waves reached 75 miles inland to Portland, would have a similar intensity as the Port-au-Prince quake, but more rhythmic and, again, lasting about eight times as long—how would the 50-year-old Memorial Coliseum fare?

"Not good," Roddey says. The best that can be said for it is that it probably wouldn't completely fall down. The structural damage would be severe, and its glass exterior would come raining off.

How about the 15-year-old Rose Garden? "Don't know. It's been built to the highest seismic standards. The seismic design codes were changed in the mid-'90s, and that was about the time it was being built. So it'll probably do OK. Doesn't have a lot of glass to shed. But it's a long span. It's got a very long interior roof."

He moves his gaze to the river. "Fremont Bridge: Ouch. Would not want to be on the Fremont Bridge. You could expect substantial damage, and even more damage to the ramps leading up to it. That's what's gonna collapse. I mean, it'll be pancake season."

"The white hats are not coming. The police and fire departments are going to be really busy. You're on your own."

Onward. "A bridge like the Steel Bridge that has those huge counterweights up high? Not good. The grain silos? Gone. Old Town? Brick-and-mortar buildings in Old Town? Collapsed. I-5?" He points to the Marquam Bridge. "That'll take some serious damage, especially the ramps. In fact, don't count on I-5 as a functioning transportation corridor. It's a goner from northern California to the Canadian border."

"The Burnside Bridge? That's pretty substantial. The Morrison Bridge? Ehh, once again, the ramps... Hawthorne? Gone. Ross Island? Gone. The St. Johns Bridge, with that long, lovely span? Toast. Houses in the West Hills?"

I hypothesize landslides. "Yes."

How bad? "Bad—let's say it happens in the dead of winter, when it's been raining and there's landslides already. And you start shaking things. And shake 'em. And shake 'em. And your house is built on little tiny twigs."

Big Pink? "Nobody knows what the effects of a subduction zone earthquake will be on tall skyscrapers (like the US Bancorp Tower). You look at a tall-span building, and you've got the long-rolling earthquake waves. So now

EARTHQUAKE EFFECTS: LIQUEFACTION AND RESONANCE

Liquefaction describes the behavior of soils in an earthquake that suddenly change from a solid state to having the consistency of a heavy liquid. Much of the Portland metro area is built on loose, granular soils with poor drainage, such as sands and gravels, the result of massive floods that swept the area about 15,000 years ago.

Many parts of the metro—the Tualatin Valley, downtown, Lake Oswego—have soils of this type. Areas of greatest concern for liquefaction are along rivers, and areas that have been built on fill—think South Waterfront, Tom McCall Park, the east-side warehouse district, the industrial corridor along Highway 30, and Portland International Airport.

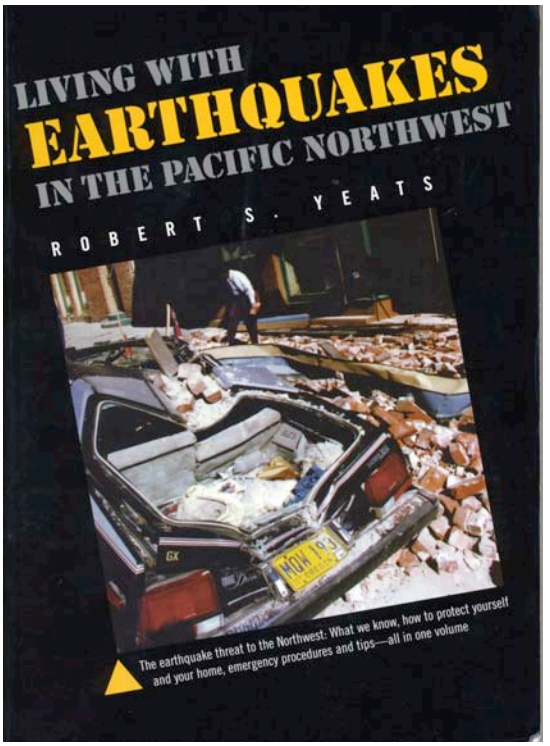
Resonance is an effect that happens when buildings of a certain height vibrate, or move at the same frequency as shallow earthquake waves. This movement begins to amplify the effects of the shock waves coming from an earthquake far away like a Cascadia Subduction Zone rupture.

Tall buildings have their own frequencies of vibration. Those that are six to fifteen stories tall vibrate at one cycle, taller buildings another cycle, making them all act like tuning forks in the event of an earthquake. The low-frequency waves of an earthquake are amplified by certain types of soils, which causes these buildings to shake more violently as the earthquake progresses.

the bottom is moving independently of the top, because you've been shaking it for so long."

Even though modern skyscrapers are built to sway in high winds, what happens if the building is resonating with the earthquake waves? "Good question. What if it reaches a point beyond where it's built to take that stress? I think it'll be an amazing thing to see. From a distance."

There are not many places you would want to be during a Cascadia Subduction Zone earthquake. A big open field would be one place. Indoors is, counter-intuitively, better than outside, because indoors you won't be pelted by the glass raining from towers like Big Pink. Portland City Hall is also one of the better spots —short, squat and retrofitted to seismic compliance.



DON'T RUN OUTSIDE: Even moderate earthquakes can have a devastating effect on older brick and mortar buildings (and the people standing next to them) as Oregon State University Professor Emeritus Robert Yeats chronicles in his book, *Living with Earthquakes in the Pacific Northwest.*

But there are many places where you would especially not want to be. The Portland Office of Emergency Management is particularly worried about 1,900 buildings—about one in 100—that are constructed from unreinforced masonry. City code requires seismic upgrades under a variety of scenarios including usage change, while alterations exceeding the rather exact figure of $219,328 trigger a safety study. In the case of unreinforced masonry buildings, seismic upgrades are required when changes for repairs exceed $37.50 to $50 per square foot—depending on the building's height. Brick-and-mortar buildings that have not been upgraded include Cameron's Books, strip club Union Jacks and the First Baptist Church.

The Department of Geology has also identified 43 Portland Public Schools buildings as high-risk, including Emerson School and the Rosemont Treatment Center for troubled teen girls. PPS downplays those findings, and says 77 school buildings had been retrofitted for seismic safety since 1995—and that bringing the rest up to current standards would cost at least $206 million.

Besides the danger to residents, unreinforced masonry buildings will litter downtown streets with bricks —that rubble, combined with what's shed from structures still standing, will block MAX and streetcar service. In fact, the most pressing question immediately after a mega-quake will be what infrastructure remains.

It's possible none of the Willamette River bridges will be functional. Any water, power and gas mains buried underground will have been destroyed. Shipping lanes on the Columbia River will be filled with sediment. Portland International Airport may not be usable, since the runways are built on a floodplain that will liquefy during the tremors.

The fact Seattle and northern California face the same overall threat exacerbates the predicament, since it means federal agencies will have to spread their resources across three states—and Hurricane Katrina showed what a heck of a job the feds can do if just responding to one city.

The most recent training exercises make the somewhat rosy estimate that fewer than 1,000 people will succumb in the Portland metro area, though privately Roddey isn't so optimistic. "These are very survivable earthquakes if you get prepared. The vast majority of buildings will be fine, and wood frame homes, steel reinforced

buildings do just fine" he says—but when you factor in contingencies like collapsing parking garages and vulnerable big box stores, the picture is less sanguine.

The news is even worse on the Oregon coast, where less than 30 minutes after the tremors subside a 30-foot tsunami will smash in and out the length of the coastline at 35 mph, pulling down buildings and raking them back and forth across the beachfront.

"It's not the water as the tsunami rolls in that kills you," Roddey says. "It's the minivan. Or the dumpster, or the coffee stand."

Even after recovery efforts are well under way, the state will have to endure aftershocks—secondary quakes on the Cascadia subduction zone as severe as a magnitude 7.5.

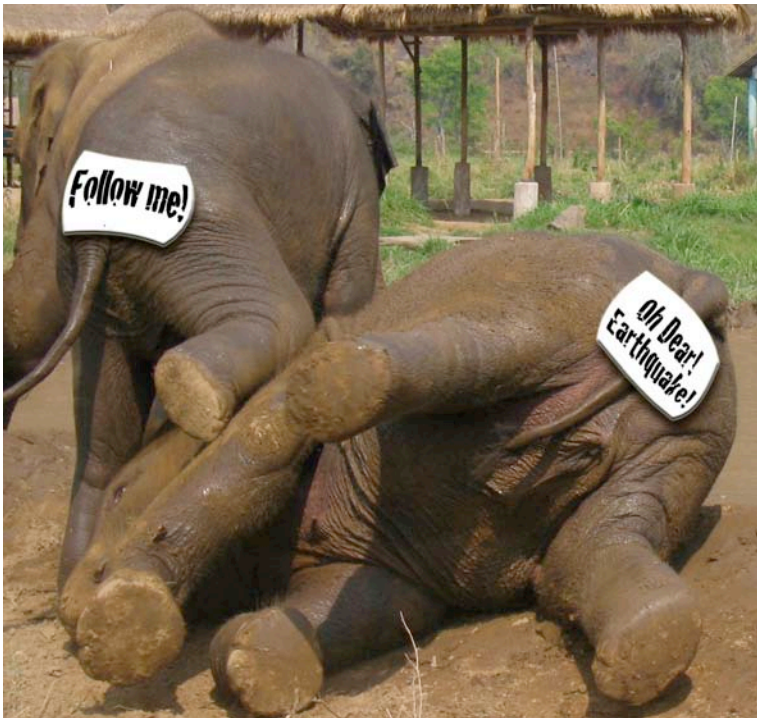
"That's the one thing that nobody figures into the emergency planning," Roddey says. "Aftershocks, for years to come."

Upon hearing all this, I begin to feel a certain overwhelmed fatalism. Roddey says my reaction is typical of civic leaders he addresses.

"Within 10 minutes," Roddey says, "their eyes glaze over and they look at their watches and think, 'I want to be someplace else'."

So Roddey has developed a new sales pitch. "I don't dwell on the death or destruction. That completely shuts people's brains down and then nobody listens. I tell stories... with a purpose."

He has, in effect, become the country's first geological motivational speaker. He peppers his presentations with funny tales, such as how Thailand's elephant herds—unlike the tourists—fled the coastline before the 2004 tsunami, and suggests: "Let's put elephants at the Oregon coast. It's a great idea. You're building a tourist attraction. Who wouldn't want to ride an elephant through the surf? And you put a big ol' sign on the elephant's butt that says, 'If I'm heading to high ground, follow me.'" (He is only *mostly* kidding.)



EARLY WARNING SYSTEM: Roddey sometimes uses this image to lighten the mood at his talks, referring to elephants that left the beaches in Thailand prior to the tsunami.

One of the most common objection he hears is that he is simply making all of this up to increase his department's state funding. (If that were the case, he hasn't been very successful: The Department of Geology's $12.9 biennial budget gets most of its money from the federal government and other agencies. Still, towns have begun to develop somewhat rudimentary disaster mitigation and response plans.

The city of Cannon Beach released a summary report in 2006 that mostly identified potential problems, including "dead/injured visitors, hotel and rental guests, employees and residents who are at work when tsunami hits" and, later on, "Long-term impact on tourism related desirability."

Roddey notes that Cannon Beach has placed dozens of 2-by-3-foot maps in public places identifying the impact of flooding and evacuation routes; it has also begun considering a plan to make its city hall the nation's first tsunami-proof evacuation shelter.

The Department of Geology, meanwhile, is this year partnering with the National Oceanic and Atmospheric Administration to

launch a four-year, $2.7 million joint effort called "TsunamiReady, TsunamiPrepared" to help coastal communities continue to get ready. "The most damage and loss of life will occur at the coast. The coast will really take a pounding from the earthquake and then the tsunami arrives."

Roddey will never have to manage such a gruesome aftermath directly. In Portland, such unpleasant preparations fall to the Portland Office of Emergency Management.

"I promise you, it's going to be ugly," says Community Emergency Services Manager Keith Berkery. "But I also promise you we couldn't have better people to work on it."

"It may sound silly, but those tsunami evacuation signs you see at the coast can save your life."

Berkery says Portlanders' skepticism about emergency management after seeing the paralysis that grips the city when it snows plays into why POEM hasn't made quick progress upgrading buildings—in both cases, nobody wants to pay for something unpredictable.

In an earthquake, POEM will become the coordinating agency for an immediate response by about 30 Neighborhood Emergency Teams (the goal is a team for every neighbor in Portland) ranging up to a couple dozen people. The teams have trained since 1994 by putting out small blazes with fire extinguishers and rescuing human-shaped bundles of fire hose from under piles of concrete.

Immediately after the shaking stops, NET volunteers are supposed to head for the nearest fire station—each one is equipped with a ham radio that hooks-up to a car battery or, if the power is on, the fire station antenna. Meanwhile, an incident command team should assemble at the Emergency Communications Center on the city's east side, where the mayor and City Council members will be taken.

POEM managers repeatedly emphasize that individual survival will depend on following simple guidelines—"drop, cover and hold on", and have an earthquake preparedness kit ready: Seven days' supply of food, a flashlight with batteries, a spare pair of glasses, "something for your feet and something for your head," all within reach of the bed.

Roddey, who has bolted a water heater with flexible gas lines to the side of his Oregon City home and some of his bookshelves to the walls ("but my 37-inch flat-screen TV's gonna be toast"), suggests people also stockpile some cash, several rolls of toilet paper—"you could probably trade toilet paper for money"—and an extra two-month supply of their prescription medications. (The aftermath of an earthquake is a terrible time to become further clinically depressed.)

As we stare out the window at the Portland skyline, I ask Roddey if, after 10 years of prophesying about Cascadia Subduction Zone earthquakes, he doesn't secretly want to be present for the big one.

"Gosh, no," he immediately replies, and laughs. "I do not. If you could divorce yourself from the human problems it's gonna create, it would be a truly amazing thing to see. But it will be a disaster of epic proportions." *Aaron Mesh.*

For more information on the effects of a Cascadia Subduction Zone earthquake in Oregon, go online to: www.OregonGeology.org